lished the observation. The things necessary to produce it appear to be :—(1) a dry film of dust on surface of water; (2) a layer of fine globules of moisture on the film; (3) a dead calm, that the globules be not shaken into coalescence; (4) the sun shining brightly at a low angle through a clear atmosphere.

EDWARD HEWITT.

Municipal Museum, Vernon Park, Stockport, November 11.

Weather Changes and the Appearance of Scum on Ponds.

IF the scum referred to (NATURE, November 5, p. 7) be organic in character—algal, for instance—it would contain bubbles of gases.

Would not these bubbles tend to enlarge, from the expansion of their contained gases, on a lowering of barometric pressure, and the mass, becoming specifically lighter, to rise?

"Platanus orientalis" says "any decided change of weather." The above explanation would hold good only for a change of weather indicated by a falling barometer.

H. J. GLOVER.

Stationers' School, Hornsey, N., November 6.

Earthquake at Kashmir.

IT may perhaps be of interest to note (I do not find the fact recorded in NATURE) that on April 18, 1902, there was a sharp earthquake shock over North-west India and Kashmir, about 2.30 a.m. (local time).

O. ECKENSTEIN.

34 Greencroft Gardens, London, N.W., November 13.

A NEW THEORY OF THE SOIL.[1]

IT has long been recognised that the chemical composition of the soil affords a very imperfect index to its fertility, partly due to the fact that only recently have methods of analysis been devised to discriminate between the total plant food in the soil and that which is active and likely to be immediately available for the plant, but chiefly because the physical texture of the soil and its power of maintaining a supply of water to the growing plant is a much larger factor in crop production than its store of nutrient material.

But though the part played by the chemistry of the soil has doubtless been much exaggerated and requires to be studied more in connection with soil physics, it has been reserved for the chemists of the United States Bureau of Soils to deny its action entirely, and put forward a theory which considers all soils to be effectively the same from the chemical standpoint.

Briefly stated, the thesis developed in the *Bulletin* before us is as follows :—dissatisfied with the want of correspondence between the results of any of the methods of soil analysis in which the soil is attacked by either weak or strong acids, Dr. Whitney and his associates have fallen back on the aqueous solution obtained by shaking 100 grams of the soil with 500 c.c. of water and allowing it to stand for twenty minutes. For the rapid quantitative examination of the very weak solution thus resulting they have worked out various colorimetric methods, and in this way have been able to analyse several hundred soils of the behaviour of which in the field something was known.

From these results the authors come to the conclusion "that with occasional exceptions the composition of the soil solution and the concentration is about the same in all cultivable soils." "All our principal soil types, in fact, practically all cultivable soils, contain naturally a nutrient solution which varies within comparatively narrow limits with regard either to composition or concentration, and which is usually sufficient for plant growth. Apparently, therefore, all soils are amply supplied with the necessary mineral plant foods, and these plant foods are not in themselves a matter of such paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil." The authors further suggest that fertilisers, if they have any effect in increasing the crop, do so in the main by altering the physical texture of the soil or by stimulating the root range of the plant. So novel a point of view from men with the experience of Dr. Whitney and his colleagues demands a careful consideration of the evidence in its support.

On the theoretical side the authors suggest that in the natural soil solution on which plants feed "the quantity of any constituent which can possibly enter the solution is . . . determined by definite equilibrium conditions with the but slightly soluble mineral from which it is derived . . . it may very well happen that the addition of comparatively small amounts of a readily soluble potassium salt to a soil would simply force back the dissociation and solubility of the potash minerals with no consequent gain of potassium to the soil solution." In support of this view the authors describe an experiment in which powdered potash felspar when shaken up with water is shown to yield a feebly alkaline solution, as indicated by phenolphthalein. On adding, however, a little soluble potassium salt the colour of the phenolphthalein is partly discharged, which the authors consider to indicate that some of the potash derived from the felspar has been forced back to the solid phase. We would suggest the consideration of another experiment; take a very weak solution of potassium phosphate, add a drop of phenolphthalein solution, and run in dilute alkali until a distinct colour appears; now add a little solution of some neutral salt, sodium or potassium chloride; the colour will again be partially discharged, although the salt added is strictly neutral.

In the latter experiment there is no question of the intervention of a solid phase; both experiments are, we think, equally explicable on the dissociation hypothesis, but the one does not bear the interpretation put on it by the American chemists.

Turning now to the analytical figures, we cannot agree that, except in a very general and average sense, they support the authors' case that the composition and concentration of the soil solution are about the same for all soils. Taking first of all the determinations of nitric acid, they are seen to vary within the widest limits, as is evident from the following summary of the results for four of the soils :—

	No. of analyses	Nitric acid. Parts per million of dry soil		Mean
		Highest	Lowest	
Windsor Sand ...	34	26·62	0·56	5·69
Norfolk Sand ...	98	23·76	0·67	3·81
Leonardtown Loam	62	62·00	trace	12·71
Sassafras Loam ...	80	38·40	0·50	7·79

Furthermore, if the number of the determinations falling within successive equal limits be plotted into a curve, the resulting figure is highly irregular, and shows nothing of the maximum about the mean which characterises the curve of error. The nitric acid figures are thus entirely opposed to the authors' thesis; they show no tendency to a constant value, but extreme accidental variations, *i.e.* due to factors independent of the classification here adopted. But in fact too

[1] "The Chemistry of the Soil as related to Crop Production." By M. Whitney and F. K. Cameron. U.S. Department of Agriculture, Bureau of Soils, No. 22. Pp. 71. (Washington, 1903.)

much is known of the origin of the nitrates in the soil from the results obtained by Warington at Rothamsted and by King in Wisconsin to allow one to suppose their amount would ever approximate to a constant even for the same soil, yet nitrates are perhaps the dominant factor in plant nutrition.

The phosphoric acid and potash figures are a little more in harmony, and we have examined those relating to the same four soils with the following results:—

	Phosphoric acid. Parts per million		
	Highest	Lowest	Mean
Windsor Sand	12·88	2·65	6·21 ± 0·25
Norfolk Sand	16·52	1·71	6·33 ± 0·19
Leonardtown Loam ...	16·5	2·9	7·16 ± 0·26
Sassafras Loam	21·45	2·24	7·61 ± 0·30

	Potassium. Parts per million		
	Highest	Lowest	Mean
Windsor Sand	46·11	10·90	24·27 ± 1·02
Norfolk Sand	44·9	11·64	22·19 ± 0·49
Leonardtown Loam ...	51·66	10·08	23·61 ± 0·65
Sassafras Loam	46·8	7·94	24·22 ± 0·63

These numbers would indicate variation round a mean which is practically the same for all soils as regards potash, but which as regards phosphoric acid has a different value for different types of soil, approaching one value for sands and another for loams. This agrees with the probability that the potash compounds are of the same type in all soils, whereas several distinct compounds of phosphoric acid must exist in relative proportions varying with the type of soil, and we surmise that these mean results might be correlated with the amount and solubility of the compounds appropriate to the various types of soil were more data available. But for the purpose of the argument we are not concerned with mean results, but with individual soils; the authors rest their case on the constancy of composition of the soil solution, and their own figures show variations too wide and too numerous to fall within any allowable limits. It may be true enough that the variations exhibited cannot be correlated with the known productiveness of the soils, but that is only a proof of the ineffectiveness of the analysis of the aqueous extract of a soil, not of the non-existence of a chemical soil factor in crop production. Indeed, it is not quite easy to see what the numbers do represent; the volume of water employed is so small, and the time of extraction so short, that they cannot stand either for the solution existing in the soil or for the material which water could extract during the growth of a crop. Some analyses are given of the actual solution extracted from various soils; all that can be said of them here is that they show no more constancy of composition than the laboratory extracts, nor do the old analyses of the drainage waters at Rothamsted lend any more support to the idea of a soil solution of constant composition.

Though Dr. Whitney's main argument is thus hardly tenable on his own showing, certain side issues are worth a little notice. Dealing with the action of fertilisers, he notices that, while the wheat crop on the best fertilised plot at Rothamsted averages about 33 bushels, on the plot which has been unmanured for sixty years it has fallen to 12 or 13 bushels. Yet on the similarly unmanured plot in the Agdell field, where the wheat is grown once every four years in rotation with roots, barley, and clover or fallow, but little falling off is apparent. Hence he concludes that, in virtue of the rotation, the fertility of the Agdell field is unimpaired, whereas in the continuous wheat field "the decrease can be ascribed only to some physical change in the soil, to some chemical change other than the actual loss of plant food taken up by the crops." But when any other crop on the unmanured plots in Agdell field is considered, the decline in fertility is enormous; roots and clover only yield minimal crops; so far as they are concerned the cultivation of the soil involved in the rotation has been quite unable to maintain the fertility. The wheat, with its powerful root system, holds up better, but its production is falling steadily; it is important to see how long it will be maintained, though it need never be expected to fall to the level of the continuous wheat, because the land is practically only cropped every other year, so trifling has the output of roots become.

When Dr. Whitney says that there are few instances showing that a given fertiliser is required by a certain soil, and that generally fertilisers have no consistent or continuous effect, he ignores too much the results both of experiment and experience in countries like our own. In England a body of knowledge has been accumulated concerning the requirements of particular soils and crops for specific fertilisers such as is hardly possible in America, where much of the land has only recently been brought under intensive cultivation involving the use of purchased manures.

In another place Dr. Whitney says "the beneficial effect of fallowing is not due to an accumulation of soluble plant food in the soil." Not wholly due, perhaps, but King's investigations show what a powerful factor the accumulated nitrates become, and a recent discussion of the Rothamsted results shows that after a wet autumn, to wash out the nitrates formed during the summer fallow, the benefit of fallowing disappears almost entirely, whereas after a dry autumn and early winter it produces an increase of crop of nearly 50 per cent.

Suggestive as Dr. Whitney's memoir must be to all agricultural chemists, we thus do not consider that the main theory it propounds possesses any permanent value. We should be sorry if we have failed to appreciate the argument properly, but it is not always easy to follow, the text being somewhat deficient in sequence and orderly arrangement; indeed, we are disposed to think that had the question been set out a little more nakedly at the outset, and the demonstration marshalled with more precision, a somewhat different conclusion would have been reached by the authors. The fundamental thesis is unimpeachable, that water content and temperature are the main factors in crop production, but the chemical composition of the soil is also a large factor, though its magnitude and relation to the other physical factors do not yet admit of complete determination.

A. D. H.

THE SURVEY OF INDIA.

A VOLUME of extracts from narrative reports of the Survey of India for the season 1900–1901 [1] has recently been issued. These extracts, which used to be published in the same volume as the annual report, are now issued separately. The reports selected for publication show admirably the range of the operations of the Survey of India. They deal with seven subjects.

(1) *Zincography.*—For certain classes of maps reproduction from zinc is eminently suitable, and owing to the introduction of thin zinc plates, difficulties of

[1] Pp. 68. (Calcutta: Government Printing Office, 1903.) Price 2s. 3d.